

CLAIM AMENDMENTS

Kindly amend claims 11, 61 and 73 as shown in the following listing of claims. This listing of claims will replace all prior versions, and listings, of claims in the application.

LISTING OF CLAIMS

- 1 Claim 1. (original) A beam steering module comprising:
2 one or more beam steering elements, wherein the one or more beam steering elements
3 deflect one or more optical signals in two dimensions, wherein the module can co-operate
4 interchangeably with one or more optical components in an optical beam steering device.
- 1 Claim 2. (original) The module of claim 1 wherein the optical component includes a reflector.
- 1 Claim 3. (original) The module of claim 1 further comprising a collimator array mechanically
2 coupled to module and optically coupled to beam steering elements.
- 1 Claim 4. (original) The module of claim 3, wherein the collimator array is removably attached to
2 the module.
- 1 Claim 5. (original) The module of claim 1 wherein the optical component includes one or more
2 other beam steering modules.
- 1 Claim 6. (original) The module of claim 5, wherein the beam steering modules are part of an
2 optical switch.
- 1 Claim 7. (original) The module of claim 1 wherein the optical signals enter and leave the module
2 along substantially parallel paths.
- 1 Claim 8. (original) The module of claim 1, further comprising one or more collimators optically
2 coupled to the one or more beam steering elements.
- 1 Claim 9. (original) The module of claim 8, further comprising an array of photodetectors
2 clustered around one or more of said one or more collimators.

- 1 Claim 10. (original) The module of claim 1, further comprising at least one fiber coupler having
2 a hole coupled to the module.
- 1 Claim 11. (currently amended) [[the]] The module of claim 10 further comprising a collimator
2 disposed in the hole.
- 1 Claim 12. (original) The module of claim 1, wherein the one or more beam steering elements
2 include a first deflector array optically coupled to a second deflector array, wherein the
3 first and second deflector arrays co-operate to steer an optical signal in two dimensions.
- 1 Claim 13. (original) The module of claim 12, wherein one or more of the first and second
2 deflector arrays includes an $L \times M$ array of deflectors, where L and M are integers greater
3 than or equal to one.
- 1 Claim 14. (original) The module of claim 13, wherein N first and second deflector arrays are
2 stacked to form an $N \times L \times M$ beam steering module, where N is an integer greater than or
3 equal to 1.
- 1 Claim 15. (original) The module of claim 12, wherein one or more of the beam steering elements
2 includes a frame, wherein the first and second arrays are coupled to opposite sides of the
3 frame in a staggered configuration.
- 1 Claim 16. (original) The module of claim 15 wherein the frame includes one or more holes
2 between the two or more arrays one at least one side of the frame.
- 1 Claim 17. (original) The module of claim 12, wherein at least one of the first and second arrays is
2 a double-sided array.
- 1 Claim 18. (original) The module of claim 17, wherein the double sided array includes two
2 substrates back-to-back, wherein each substrate has one or more deflectors on one side.
- 1 Claim 19. (original) The module of claim 18 wherein the back-to-back substrates are separated by
2 an air gap.

- 1 Claim 20. (original) The module of claim 17, wherein the double sided array includes a single
2 substrate having one or more deflectors on each side thereof.
- 1 Claim 21. (original) The module of claim 12, wherein the first array includes one or more
2 deflectors configured to rotate about a single first axis.
- 1 Claim 22. (original) The module of claim 21 further comprising relay optics optically coupled to
2 one or more of the first and second deflector arrays.
- 1 Claim 23. (original) The module of claim 21 wherein the second array includes one or more
2 deflectors configured to rotate about a single second axis.
- 1 Claim 24. (original) The module of claim 23 wherein the first axis is substantially perpendicular
2 to the second axis.
- 1 Claim 25.(original) The module of claim 23 wherein the deflectors in the first and second arrays
2 are optically coupled in a one-to-one correspondence.
- 1 Claim 26. (original) The module of claim 23, wherein at least one of the first and second
2 deflector arrays is a double-sided array.
- 1 Claim 27. (original) The module of claim 23 wherein N first and second deflector arrays are
2 stacked.
- 1 Claim 28. (original) The module of claim 23 further comprising relay optics optically coupled to
2 one or more of the first and second deflector arrays.
- 1 Claim 29. (original) The module of claim 21, wherein at least one of the first and second arrays
2 is double-sided array.
- 1 Claim 30. (original) The module of claim 29 wherein the double-sided array includes one or
2 more deflectors on one side configured to rotate about a first axis and one or more
3 deflectors on another side configured to rotate about a second axis.

1 Claim 31. (original) The module of claim 29, wherein N of said double-sided arrays are stacked,
2 wherein N is an integer greater than 1.

1 Claim 32. (original) The module of claim 12, wherein the first deflector array includes one or
2 more dual-axis deflectors configured to rotate about a first axis and a second axis.

1 Claim 33. (original) The module of claim 32 wherein the second array includes one or more
2 fixed deflectors.

1 Claim 34. (original) The module of claim 32, wherein the one or more dual-axis deflectors
2 includes one or more double-sided dual axis deflectors.

1 Claim 35. (original) The module of claim 34, wherein the one or more double-sided dual axis
2 deflectors includes two substrates back-to-back, wherein each substrate has one or more
3 deflectors on one side.

1 Claim 36. (original) The module of claim 35 wherein the back-to-back substrates are separated
2 by an air gap.

1 Claim 37. (original) The module of claim 34, wherein the one or more double-sided dual-axis
2 deflectors includes a single substrate having one or more deflectors on each side thereof.

1 Claim 38. (original) The module of claim 32 wherein the second deflector array includes one or
2 more double-sided fixed deflectors.

1 Claim 39. (original) The module of claim 38, wherein the one or more double-sided fixed
2 deflectors includes two substrates back-to-back, wherein each substrate has one or more
3 deflectors on one side.

1 Claim 40. (original) The module of claim 39 wherein the back-to-back substrates are separated
2 by an air gap.

1 Claim 41. (original) The module of claim 38, wherein the one or more double-sided fixed
2 deflectors includes a single substrate having one or more deflectors on each side thereof.

1 Claim 42. (original) An optical switch, comprising:

2 a) a first beam steering module;

3 b) a second beam steering module optically coupled to the first beam steering module;

4 wherein at least one of the first and second beam steering modules includes at least one
5 beam steering element, wherein the at least one beam steering element deflects an optical
6 signal in two dimensions, wherein at least one of the first and second modules can co-
7 operate interchangeably with one or more optical components in the optical switch.

1 Claim 43. (original) The switch of claim 42 wherein the optical signals enter and leave the
2 module along substantially parallel paths.

1 Claim 44. (original) The switch of claim 42, further comprising one or more collimators coupled
2 to the at least one beam steering element.

1 Claim 45. (original) The switch of claim 42, further comprising a fiber coupler connected to one
2 or more of the first and second beam steering modules, the fiber coupler having hole.

1 Claim 46. (original) The switch of claim 45, further comprising a collimator disposed in hole.

1 Claim 47. (original) The switch of claim 42, further comprising a collimator array mechanically
2 coupled to one or more of the first and second beam steering modules, wherein the
3 collimator array is optically coupled to the at least one beam steering element.

1 Claim 48. (original) The switch of claim 42, wherein the at least one beam steering element
2 includes a stack containing one or more first deflector arrays optically coupled to one or
3 more second deflector arrays wherein one or more of the first and second deflector arrays
4 includes a double sided array having on one side one or more deflectors configured to
5 rotate about a single first axis, the double sided array having on another side one more
6 deflectors configured to rotate about a single second axis.

1 Claim 49. (original) The switch of claim 48 further comprising relay optics optically coupled to
2 one or more of the first and second beam steering elements.

1 Claim 50. (original) The switch of claim 49, further comprising relay optics coupled to one or
2 more of the first and second modules.

1 Claim 51. (original) The switch of claim 49 wherein the first and second beam steering modules
2 are part of a plurality of first and second beam steering modules disposed along a curved
3 surface.

4 Claim 52. (original) The switch of claim 51 further comprising a fold deflector optically coupled
5 between the first and second beam steering modules.

1 Claim 53. (original) The switch of claim 52 wherein the fold deflector is partially transparent.

1 Claim 54. (original) The fold deflector of claim 53, further comprising a photodetector array
2 optically coupled to the partially transparent fold deflector.

1 Claim 55. (original) The switch of claim 42, wherein the at least one beam steering element
2 includes a stack containing one or more first deflector arrays optically coupled to one or
3 more second deflector arrays wherein one or more of the first and second deflector arrays
4 includes a double sided array having on one side one or more deflectors configured to
5 rotate about a first axis and a second axis, the double sided array having on another side
6 one more fixed deflectors.

1 Claim 56. (original) The switch of claim 55 wherein the first and second beam steering modules
2 are part of a plurality of first and second beam steering modules disposed along a curved
3 surface.

1 Claim 57. (original) The switch of claim 56 further comprising a fold deflector optically coupled
2 between the first and second beam steering modules.

1 Claim 58. (original) The switch of claim 42, wherein the one or more beam steering elements
2 includes a stack containing one or more first deflector arrays optically coupled to one or
3 more second deflector arrays wherein one or more of the first and second deflector arrays
4 includes a double sided array having on one side one or more fixed deflectors, the double

5 sided array having on another side one more deflectors configured to rotate about a first
6 axis and a second axis.

1 Claim 59. (original) The switch of claim 58 wherein the first and second beam steering modules
2 are part of a plurality of first and second beam steering modules disposed along a curved
3 surface.

1 Claim 60. (original) The switch of claim 59 further comprising a fold deflector optically coupled
2 between the first and second beam steering modules.

1 Claim 61. (currently amended) The switch of claim 42, further comprising a fold deflector
2 optically coupled between the first and second beam steering modules.

1 Claim 62. (original) The switch of claim 61, wherein the fold deflector is a curved fold mirror.

1 Claim 63. (original) The switch of claim 62, wherein the first and second modules are arranged
2 in a substantially planar configuration.

1 Claim 64. (original) The switch of claim 62, wherein the first and second modules are arranged
2 in a substantially curved configuration.

1 Claim 65. (original) The switch of claim 42, wherein the first and second modules are arranged
2 in a substantially planar configuration.

1 Claim 66. (original) The switch of claim 42, wherein the first and second modules are arranged
2 in a substantially curved configuration.

1 Claim 67. (original) An optical switch comprising at least one beam steering module having at
2 least one beam steering element, wherein the at least one beam steering element deflects
3 an optical signal in two dimensions, wherein the module can co-operate interchangeably
4 with one or more optical components in the optical switch.

1 Claim 68. (original) The optical switch of claim 67 further comprising a fold deflector coupled to
2 the at least one beam steering module.

- 1 Claim 69. (original) The optical switch of claim 67, wherein the optical components include one
2 or more other beam steering modules.
- 1 Claim 70. (original) The optical switch of claim 71 wherein the at least one beam steering
2 module is removable from the switch.
- 1 Claim 71. (original) The optical switch of claim 71 further comprising a power tap optically
2 coupled to the beam steering element, the switch further comprising a controller coupled
3 to beam steering element and the power tap in a feedback loop.
- 4 Claim 72. (original) The switch of claim 71 further comprising a calibration light source coupled
5 to the beam steering element and power tap.
- 6 Claim 73. (currently amended) The switch of claim 72 wherein the calibration light source
7 provides a fixed frequency light that doesn't conflict with a signal frequency[[,]].
- 1 Claim 74. (original) The switch of claim 67, wherein the optical signals enter and leave the
2 switch along substantially parallel paths.
- 1 Claim 75. (original) The switch of claim 67, further comprising one or more collimators optically
2 coupled to the beam steering element.
- 1 Claim 76. (original) The switch of claim 67 further comprising a fiber coupler connected to one
2 or more of the first and second beam steering modules, the fiber coupler having hole.
- 1 Claim 77. (original) The switch of claim 77, further comprising a collimator disposed in hole.
- 1 Claim 78. (original) The switch of claim 67, wherein the at least one beam steering element
2 includes a first deflector array optically coupled to a second deflector array.
- 1 Claim 79. (original) The switch of claim 78, wherein one or more of the first and second
2 deflector arrays includes an LxM array of deflectors, where L and M are integers greater
3 than or equal to one.

- 1 Claim 80. (original) The switch of claim 79, wherein N of said LxM arrays are stacked to form
2 an NxLxM beam steering element.
- 1 Claim 81. (original) The switch of claim 78, wherein the at least one beam steering element
2 includes a frame wherein the first and second arrays are coupled to opposite sides of the
3 frame in a staggered configuration the frame w/holes to let beams pass.
- 1 Claim 82. (original) The switch of claim 78, wherein at least one of the first and second deflector
2 arrays includes one or more double-sided arrays of deflectors.
- 1 Claim 83. (original) The switch of claim 78, wherein the first array includes one or more
2 deflectors configured to rotate about a single first axis.
- 1 Claim 84. (original) The switch of claim 83, wherein the second array includes one or more
2 deflectors configured to rotate about a single second axis.
- 1 Claim 85. (original) The switch of claim 84 wherein the first and second arrays include one or
2 more stacked double-sided arrays.
- 1 Claim 86. (original) The switch of claim 84 wherein the deflectors in the first array are optically
2 coupled to the deflectors in the second array in a one-to-one correspondence.
- 1 Claim 87. (original) The switch of claim 84, further comprising relay optics optically coupled to
2 one or more of the first and second arrays.
- 1 Claim 88. (original) The switch of claim 84 wherein the first axis is substantially perpendicular
2 to the second axis.
- 1 Claim 89. (original) The switch of claim 83, wherein the first and second arrays include one or
2 more double-sided arrays.
- 1 Claim 90. (original) The switch of claim 83, wherein the first and second arrays include one or
2 more stacked double-sided arrays.

1 Claim 91. (original) The switch of claim 83, further comprising relay optics optically coupled to
2 one or more of the first and second arrays.

1 Claim 92. (original) The switch of claim 78, wherein the first array includes one or more dual-
2 axis deflectors configured to rotate about a first axis and a second axis.

1 Claim 93. (original) The switch of claim 92, wherein the second array includes one or more fixed
2 deflectors.

1 Claim 94. (original) The switch of claim 93 wherein the one or more fixed deflectors is a single
2 continuous fixed deflector.

1 Claim 95. (original) The switch of claim 92, wherein the one or more dual-axis deflectors
2 includes one or more double-sided dual axis deflectors.

1 Claim 96. (original) The switch of claim 95, wherein the second array includes a single
2 continuous fixed deflector.

1 Claim 97. (original) The switch of claim 95 wherein the one or more dual-axis deflectors
2 includes a double-sided dual-axis deflector optically coupled to a double-sided fixed
3 deflector in a sandwich.

1 Claim 98. (original) The switch of claim 97 wherein a plurality of said sandwiches are stacked.

1 Claim 99. (original) The switch of claim 92, wherein one or more of the first and second arrays
2 includes a double-sided array having one or more dual-axis deflectors on one side and
3 one or more fixed deflectors on the other side.

1 Claim 100. (original) The switch of claim. 99, wherein a plurality of said double-sided arrays are
2 stacked.

1 Claim 101. (withdrawn) An optical switch, comprising:

- 2 a) a first set of optical I/O ports distributed across a first curved surface;
3 b) a second set of optical I/O ports distributed across a second curved surface; and

4 c) a set of beam steering elements optically coupled between the set of inputs and the set of
5 outputs.

1 Claim 102. (withdrawn) The switch of claim 101, further comprising a fold deflector optically
2 coupled between the first and second sets of I/O ports.

1 Claim 103. (withdrawn) The switch of claim 102, wherein the fold deflector is a curved fold
2 mirror.

1 Claim 104 (withdrawn) The switch of claim 101, wherein the first and second surfaces are in a
2 substantially offset alignment with respect to one another and said beam steering elements
3 include one-way scanning deflectors.

1 Claim 105 (withdrawn) The switch of claim 101, wherein the first and second surfaces are in a
2 substantially opposed alignment with respect to one another and said beam steering elements
3 include two-way scanning deflectors.

1 Claim 106. (withdrawn) The switch of claim 101, wherein the beam steering elements are
2 arranged in one or more modules.

1 Claim 107. (withdrawn) The switch of claim 106, wherein the one or more modules includes one
2 or more I/O ports.

1 Claim 108. (withdrawn) The switch of claim 107, wherein the one or more modules are
2 distributed across one or more of the first and second curved surfaces.

1 Claim 109. (withdrawn) The optical switch of claim 106, wherein the one or more modules
2 include:

- 3 i) a first array of one or more deflector elements, and
- 4 ii) a second array of one or more deflector elements disposed proximate the first linear
5 array, wherein the first and second linear arrays are substantially parallel to one
6 another,
7 wherein each deflector element in the first array is optically coupled to a
8 corresponding deflector element in the second array in a one to one correspondence,
9 wherein at least one of the first and second linear arrays includes one or more

10 steerable deflectors, whereby the beam steering module may steer one or more optical
11 signals in two dimensions.

1 Claim 110. (withdrawn) The switch of claim 109, wherein at least one of the first and second
2 arrays is a linear array.

1 Claim 111. (withdrawn) The switch of claim 106, wherein at least one of the arrays includes
2 deflectors on two sides of the array.

1 Claim 112. (withdrawn) The switch of claim 106, wherein the first array includes one or more
2 deflectors configured to rotate about a first single axis.

1 Claim 113. (withdrawn) The switch of claim 112, wherein the second array includes one or more
2 deflectors configured to rotate about a second single axis.

1 Claim 114. (withdrawn) The switch of claim 113 further comprising relay optics optically
2 coupled to one or more of the first and second arrays.

1 Claim 115. (withdrawn) The switch of claim 113, wherein the first axis is substantially
2 perpendicular to the second axis.

1 Claim 116. (withdrawn) The switch of claim 109 wherein the first array includes one or more
2 dual-axis deflectors configured to rotate about a first axis and a second axis.

1 Claim 117. (withdrawn) The switch of claim 116, wherein the second array includes one or more
2 fixed deflectors.

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